APPENDIX B:

ESIMATION OF NEW BEHAVIORAL EQUATIONS IN THE MATH STEWARD MODEL

This appendix describes how new behavioral equations were estimated for the MATH STEWARD model, Version 1996.70.[1] The equations differ in several ways from the corresponding equations in Version 1996.30 as applied in an earlier version of this study (Jacobson and Puffer April 1999, Jacobson and Puffer June 1999) and documented by Jacobson et al. (1998). We first discuss the new wage equations for the model and then consider the new labor supply and program participation equations.

A. WAGE EQUATION ESTIMATES

1. Differences from Earlier Approach

Because the MATH STEWARD model allows each household's reference person and spouse to change his or her labor supply, it is necessary to estimate the potential earnings of such individuals. Both the old and new versions of MATH STEWARD rely on wage equations from the 1992 Survey of Income and Program Participation (SIPP) panel for 1992 through 1994. Given limitations in computer memory at the time, we used only every third month of data (March, June, September, and December) and assumed that outcomes were the same for the previous two months as for the month ending each quarter. Whereas the Version 1996.30 wage equations relied on a 10 percent subsample of the model database, the Version 1996.70 equations rely on nearly the entire model database, thereby improving the precision of our estimates. For Version 1996.30, we excluded from the estimation sample those households for which we do not

[1] These same equations are used in Version 1996.80, which has a slightly different error structure, described below.

know the state of residence; for Version 1996.70, we included those individuals and dummies indicating a state group for individuals for whom the specific state was unknown.[2]

Previously, we had estimated separate equations to predict the natural log of monthly part-time earnings and the natural log of monthly full-time earnings. The decision to estimate two equations was based on the assumption that the error terms for the equations were not correlated with each other. One disadvantage of the two-equation approach was that the model would occasionally simulate higher earnings for a part-time versus full-time worker. Therefore, for Version 1996.70, we decided to predict the natural log of the hourly wage for each person. Under the assumption that part-time workers work 20 hours per week (87 hours per month) and full-time workers 40 hours per week (173 hours per month), use of the hourly wage would permit us to predict part- and full-time earning.

2. Estimation of Wage Equations

Like the Version 1996.30 wage equations, the Version 1996.70 wage equations include separate estimates for single women, married women, single men, and married men. We defined the outcome variable as the natural log of average real hourly earnings per month, where earnings includes self-employment as well as wage earnings.[3] We excluded from the estimation sample individuals under age 16 or over age 64 or those who reported hourly wages outside the range $1 to $100 (in real 1992 dollars measured by using the CPI-U).

[2] This uncertainty was present because the SIPP combined residents of certain smaller states into groups (Maine + Vermont, Iowa + North Dakota + South Dakota, and Alaska + Idaho + Montana + Wyoming).

[3] We experimented with alternative earnings definitions—such as the reported hourly wage on the primary job--but found that the wage equation estimates were similar regardless of definition.

We relied on a two-step Heckman estimation procedure to account for the fact that not all individuals report earnings for a given month. In the first-stage equation, which predicts the probability of having earnings, we included several variables assumed to have no direct effect on wages but likely to affect employment: the characteristics of children in a household, previous AFDC and Food Stamp Program participation, and the amount a state spends on administrative expenses per welfare recipient.

Both the first and second-stage (wage) equations included the following variables:

- the state unemployment rate;
- initial work tenure (in months, at the start of the SIPP panel) and initial work tenure squared;
- net work tenure (cumulative months worked since the start of the panel) and net work tenure squared;
- indicators for black, Hispanic, and other nonwhite persons;
- age (in years) and age squared;
- years of schooling completed;
- a disability indicator;
- year and quarter indicators; and
- single-state indicators (except for the states grouped together by the SIPP).

Because work tenure was measured incompletely for some spouses of reference ("key") persons (for example, spouses who entered the sample after the start of the panel), we set all work tenure variables for these persons to zero. To approximate the tenure of non-key persons, we included in the regressions an indicator for non-key persons as well as the interaction of this indicator with age, age squared, and schooling.

Table B.1 indicates the estimated coefficients of the wage equations but does not report the quarter and state variables. While a higher state unemployment rate was associated with

significantly lower wages for single women (evidence perhaps of lower demand for workers), its relationship with the wages of other categories of individuals was not statistically significant. The estimated coefficient was actually slightly positive for married individuals, an outcome that we considered spurious; we thus constrained the coefficient to be zero for simulation purposes.

In the estimated wage equations, several variables frequently had statistically significant relationships to hourly earnings. Initial work tenure and net work tenure were both associated with higher earnings as was the individual's age (albeit at a decreasing rate) and years of schooling. A disability was generally associated with significantly lower earnings. In the case of men, black and Hispanic individuals earned significantly less per hour than whites, whereas women of different races evidenced no statistically significant wage differentials.

B. LABOR SUPPLY AND PROGRAM PARTICIPATION EQUATIONS

1. Differences from Earlier Approach

As with the wage equations, the labor supply and program participation equations for the MATH STEWARD model were estimated from the 1992 SIPP panel, including 12 months of data spaced at three-month intervals between March 1992 and December 1994. While the 1996.30 equations were estimated by using a 10 percent sub-sample from the model database, the 1996.70 equations used the full database for the months following March 1992. In both instances, however, we excluded from the estimation households for which the precise state of residence was unknown, since we wanted to minimize the measurement error in potential welfare benefits. Initial levels of program participation were set based on reported participation in eligible programs in March 1992 .

TABLE B.1
Estimates of Log Hourly Wage Equations for the MATH STEWARD Model, Versions 1996.70/1996.80

Variable	*Women*						*Men*					
	Single			*Married*			*Single*			*Married*		
	Coefficient		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*
Constant term	2.99E-01	**	1.24E-01	1.84E-01		2.18E-01	6.05E-01	**	1.73E-01	8.32E-01	**	1.22E-01
State unemployment rate (%)	-1.32E-02	**	5.19E-03	---		---	-5.14E-03		8.37E-03	---		---
Initial work tenure	3.42E-03	**	1.03E-03	6.65E-03	**	1.63E-03	3.91E-03	**	1.21E-03	1.38E-03		7.51E-04
Initial tenure squared	1.96E-07		7.77E-06	-2.90E-05	**	1.33E-05	-6.67E-06		9.72E-06	6.67E-06		5.81E-06
Net work tenure	2.73E-03	**	8.31E-04	2.57E-03	**	8.72E-04	1.91E-03	**	8.30E-04	1.22E-03	**	4.94E-04
Net tenure squared	8.51E-06		9.12E-06	1.99E-05		1.30E-05	6.10E-06		1.13E-05	6.10E-06		5.69E-06
Key person is black	-4.21E-02		2.40E-02	2.43E-02		2.95E-02	-1.13E-01	**	4.55E-02	-1.54E-01	**	2.45E-02
Key person is Hispanic	-1.62E-02		3.25E-02	-3.88E-02		2.77E-02	-1.60E-01	**	4.79E-02	-1.86E-01	**	2.50E-02
Key person is other race	-4.76E-02		6.47E-02	-3.70E-02		4.95E-02	-1.37E-01		9.98E-02	-1.53E-01	**	4.68E-02
Age	4.40E-02	**	4.90E-03	2.82E-02	**	1.01E-02	5.78E-02	**	8.16E-03	4.75E-02	**	5.61E-03
Age squared	-4.90E-04	**	5.92E-05	-3.10E-04	**	1.29E-04	-6.30E-04	**	1.09E-04	-5.20E-04	**	6.66E-05
Years of schooling	7.75E-02	**	5.18E-03	8.77E-02	**	8.89E-03	3.65E-02	**	6.88E-03	4.91E-02	**	3.60E-03
Person is disabled	-1.06E-01	**	2.72E-02	-8.97E-02	**	2.43E-02	-1.43E-01	**	5.08E-02	-9.64E-02	**	2.26E-02
Person is not key person	--		--	1.92E-01		2.41E-01	--		--	-2.00E-01		2.44E-01
Not key person * age	--		--	1.03E-02		1.14E-02	--		--	1.96E-02		1.20E-02
Not key person * age squared	--		--	-8.80E-05		1.45E-04	--		--	-1.80E-04		1.47E-04
Not key person * schooling	--		--	-1.74E-02		9.41E-03	--		--	-1.25E-02		7.54E-03
Sample size – second stage	35,781			84,126			23,136			84,126		
Sample size – first stage	15,294			34,066			11,488			40,755		

SOURCE: MATH STEWARD model database, 1992-1994 data from 1992 SIPP panel. Sample restricted to individuals ages 16 to 64, and excludes persons with reported hourly wages under $1 or over $100 (in 1992 dollars). Estimates obtained through two-stage Heckman procedure (first stage estimates not shown). Fixed effects for individual months and individual states not shown. Standard errors adjusted for clustering.

** = significantly different from zero (.05 level), two-tailed test

The older version of MATH STEWARD relied on a multinomial logit model to predict household labor supply and program participation. Households were allowed three labor supply choices per worker: no work (0 hours per month), part-time work (reported as 1 to 129 hours per month), and full-time work (reported as 130 or more hours per month). In addition, a household could elect to participate in AFDC/TANF[4] plus food stamps (if eligible units could be formed in the household), in food stamps only, or in neither program. Given the assumption inherent in the multinomial logit model, the simulation assumed that the unobserved factors—the residuals—determining work and program participation choices are uncorrelated with each other. Relaxing this assumption was a major goal of the reestimation of the labor supply and program participation equations.

To enable the estimation of correlations of different residuals, we estimated a series of bivariate probit models in which separate equations determined female work status, male work status, food stamp participation, and AFDC/TANF participation. We assumed that part- and full-time work by the same person was determined by the same underlying residual. For Version 1996.70 of the model, we assumed that the residual determining work did not vary for the same individual across the three-year period but that the residual determining program participation differed from month to month. (The earlier equations assumed that both types of residuals varied across months, with no correlation between months.) This assumption was motivated by the

[4] During the period 1992-1994, Aid to Families with Dependent Children (AFDC) was the principal welfare program for families with children. The Temporary Assistance to Needy Families (TANF) program was not enacted until 1996, and is assumed to be the equivalent to AFDC within the model of program participation.

belief that the unobserved factors determining program participation by these households are more volatile over a three-year period than the unobserved factors determining labor supply.[5]

The Version 1996.30 labor supply equations varied with the sex and marital status of each potential worker but assumed that the same parameters governing the program participation of single individuals governed the program participation of married-couple households. The Version 1996.70 equations, in contrast, allow both labor supply and program participation to vary with different sets of parameters, depending on whether the household's reference person is a single male, single female, or a married couple.

2. Estimation of Labor Supply Equations

The dependent variables included in the labor supply equations were the following:

- the state unemployment rate;
- the gain in disposable income from part- or full-time work (as applicable) which was calculated in terms of the program participation choice, and the spouse's employment choice in the previous month;
- initial work tenure (in months, at the start of the SIPP panel) and initial work tenure squared;
- net work tenure (cumulative months worked since the start of the panel) and net work tenure squared;
- indicators for black, Hispanic, and other nonwhite persons;
- counts of the number of own children under the age of 18 and under the age of five;
- indicators that one (and one's spouse, if applicable) is under the age of 25, age 35 to 44, age 45 to 54, age 55 to 64, and age 65 and over;
- years of schooling completed by oneself and one's spouse (if applicable);
- a disability indicator for oneself and one's spouse; and

[5] For Version 1996.80 of the model, we assumed that both the labor supply residuals and the program participation residuals were uncorrelated across months, though correlated with each other in a single month. The results obtained using this version of the model were generally similar to those obtained using Version 1996.70.

- year and quarter indicators.

As we did for the wage equations, we set all work tenure variables for non-key persons to zero. To approximate the tenure of non-key persons, we included in the regressions an indicator for non-key persons as well as the interaction of this indicator with age, age squared, and schooling.

Tables B.2 and B.3 display the estimated parameters of labor supply equations for men and women, respectively. In general, higher unemployment rates are associated with a greater likelihood that someone will be without work or without full-time work. Individuals with young children, or who are over age 54, or who are disabled, or who are married with an elderly and disabled spouse, are also less likely to be employed at all or full-time. As expected, increases in work tenure, or gains in disposable income from work, are generally associated with higher probabilities of being employed and of being employed full-time (that is, with lower probabilities of being without work or without full-time work). There is a degree of concavity to these relationships, however, as would be predicted by economic theory. While one's own years of schooling is always associated with significantly higher rates of employment, the schooling of one's spouse is associated with lower levels of employment for married women.

3. Estimation of Program Participation Equations

The dependent variables included in the program participation equations were the following:

- the state unemployment rate;
- the gain in disposable income from Food Stamp Program (FSP) participation and from AFDC/TANF participation, calculated in terms of the employment and other program participation choices of the previous month;
- initial food stamp (or AFDC/TANF) status as of the first month (March 1992);
- net food stamp (or AFDC/TANF) tenure (cumulative months of participation since the start of the panel) and net tenure squared;

TABLE B.2

Probit Estimates of Female Labor Supply Equations for the Math STEWARD Model, Versions 1996.70/1996.80

Variable	*Single Women*						*Married Women*					
	Work Zero Hours			*Work Less Than Full-Time*			*Work Zero Hours*			*Work Less Than Full-Time*		
	Coefficient.		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*
Constant term	1.78E-01		1.40E-01	6.12E-01	**	1.61E-01	5.00E-01	**	1.05E-01	7.88E-02		2.09E-01
State unemployment rate (%)	3.39E-02	**	1.23E-02	1.83E-02		1.40E-02	5.93E-02	**	3.71E-03	4.37E-02	**	9.04E-03
Gain in income from work	-7.08E-04	**	7.51E-05	-8.72E-04	**	1.12E-04	-5.05E-03	**	3.11E-04	-1.38E-03	**	1.77E-04
Gain in income^2 from work	5.03E-09	**	1.33E-09	8.20E-08	**	1.15E-08	2.76E-07	**	2.69E-08	1.64E-07	**	3.60E-08
Initial work tenure	-6.89E-03	**	1.97E-03	-7.17E-03	**	2.17E-03	-1.94E-02	**	1.86E-03	-2.03E-02	**	3.28E-03
Initial work tenure^2	3.36E-05	**	1.61E-05	1.42E-05		1.71E-05	1.05E-04	**	1.57E-05	1.03E-04	**	2.74E-05
Net work tenure	-2.84E-01	**	6.36E-03	-2.32E-01	**	8.12E-03	-2.07E-01	**	5.74E-03	-1.21E-01	**	7.48E-03
Net work tenure^2	5.14E-03	**	1.83E-04	3.97E-03	**	1.89E-04	4.93E-03	**	1.83E-04	2.78E-03	**	2.10E-04
Key person is black	7.78E-02		4.72E-02	8.23E-02		5.60E-02	-1.64E-01	**	2.23E-02	-3.16E-01	**	5.60E-02
Key person is Hispanic	-1.20E-03		6.55E-02	-1.39E-01		8.43E-02	2.79E-02		2.05E-02	-7.65E-02		5.28E-02
Key person is other race	1.50E-01		1.18E-01	2.11E-01		1.35E-01	3.75E-02		2.83E-02	-2.62E-01	**	7.71E-02
No. of own children under 18	6.32E-02	**	2.22E-02	1.05E-01	**	2.76E-02	1.68E-01	**	6.06E-03	2.09E-01	**	1.51E-02
No. of own children under 5	1.44E-01	**	4.61E-02	9.27E-02		5.29E-02	3.01E-01	**	1.06E-02	2.65E-01	**	2.60E-02
Woman is under age 25	1.73E-02		6.12E-02	3.32E-01	**	6.64E-02	7.74E-02		7.78E-02	-5.09E-02		1.18E-01
Woman is age 35 to 44	3.77E-02		5.74E-02	2.68E-02		5.61E-02	-1.91E-02		4.56E-02	3.02E-02		8.54E-02
Woman is age 45 to 54	-3.85E-01	**	6.22E-02	-4.54E-01	**	6.92E-02	-5.20E-01	**	6.36E-02	-5.48E-01	**	1.32E-01
Woman is age 55 to 64	5.35E-01	**	6.61E-02	6.22E-01	**	7.42E-02	3.81E-01	**	6.38E-02	7.27E-01	**	1.34E-01
Woman is age 65+	1.11E+00	**	6.30E-02	1.45E+00	**	8.80E-02	6.51E-01	**	6.64E-02	1.28E+00	**	2.10E-01
Woman's years of schooling	-2.34E-02	**	7.22E-03	-3.59E-02	**	8.82E-03	-2.99E-02	**	6.91E-03	-2.94E-02	**	1.39E-02
Woman is disabled	4.77E-01	**	4.53E-02	5.03E-01	**	5.72E-02	6.11E-01	**	1.52E-02	5.97E-01	**	4.19E-02
Woman is not key person	---		---	---		---	-5.26E-01	**	1.02E-01	-1.57E-01		2.09E-01
Not key person * schooling	---		---	---		---	-6.47E-02	**	7.10E-03	-5.52E-02	**	1.46E-02
Not key person * age < 25	---		---	---		---	1.11E-01		8.03E-02	2.74E-01	**	1.30E-01
Not key person * age 35 to 44	---		---	---		---	-1.14E-01	**	4.61E-02	-1.35E-01		8.85E-02
Not key person * age 45 to 54	---		---	---		---	9.32E-02		6.41E-02	1.68E-01		1.37E-01
Not key person * age 55 to 64	---		---	---		---	8.96E-02		5.97E-02	-2.62E-01	**	1.27E-01
Not key person * age 65+	---		---	---		---	8.89E-01	**	6.06E-02	4.85E-01	**	2.07E-01
Husband is under age 25	---		---	---		---	2.81E-02		4.12E-02	1.75E-01	**	7.36E-02
Husband is age 35 to 44	---		---	---		---	7.34E-02	**	1.86E-02	8.28E-02	**	4.20E-02
Husband is age 45 to 54	---		---	---		---	-1.85E-01	**	2.10E-02	-1.41E-01	**	5.13E-02
Husband is age 55 to 64	---		---	---		---	3.36E-01	**	3.02E-02	2.46E-01	**	7.13E-02
Husband is age 65+	---		---	---		---	6.80E-01	**	3.62E-02	5.55E-01	**	9.12E-02
Husband's years of schooling	---		---	---		---	1.55E-02	**	2.11E-03	3.17E-02	**	5.58E-03
Husband is disabled	---		---	---		---	4.21E-02	**	1.45E-02	6.23E-04		3.91E-02
Sample size	47,433			47,433			92,440			92,440		

SOURCE: MATH STEWARD model database, 1992–1994 data from 1992 SIPP panel. Fixed effects for individual months not shown. Standard errors adjusted for clustering.

** = significantly different from zero (.05 level), two-tailed test.

TABLE B.3
Probit Estimates of Male Labor Supply Equations for the Math STEWARD Model, Versions 1996.70/1996.80

Variable	*Single Men*						*Married Men*					
	Work Zero Hours			*Work Less Than Full-Time*			*Work Zero Hours*			*Work Less Than Full-Time*		
	Coefficient.		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*
Constant term	-2.12E-01		1.65E-01	1.93E-02		1.84E-01	-2.44E-01	**	6.99E-02	2.23E-01		1.21E-01
State unemployment rate (%)	5.56E-02	**	1.54E-02	3.46E-02	**	1.53E-02	3.94E-02	**	5.33E-03	3.78E-02	**	9.20E-03
Gain in income from work	-2.35E-04	**	4.60E-05	-4.95E-04	**	9.23E-05	4.77E-04	**	5.06E-05	-2.75E-03	**	1.72E-04
Gain in income^2 from work	5.91E-09	**	1.27E-09	3.64E-08	**	7.26E-09	-2.11E-07	**	1.79E-08	3.08E-07	**	3.02E-08
Initial work tenure	-3.48E-03		2.41E-03	-5.52E-03	**	2.47E-03	-1.19E-02	**	9.58E-04	-1.07E-02	**	1.50E-03
Initial work tenure^2	8.17E-06		1.95E-05	1.39E-05		1.97E-05	7.12E-05	**	7.54E-06	5.84E-05	**	1.17E-05
Net work tenure	-2.76E-01	**	8.71E-03	-2.35E-01	**	9.97E-03	-2.44E-01	**	3.73E-03	-1.80E-01	**	5.20E-03
Net work tenure^2	4.80E-03	**	2.47E-04	3.88E-03	**	2.49E-04	4.53E-03	**	1.12E-04	3.31E-03	**	1.44E-04
Key person is black	1.51E-01	**	6.84E-02	-8.23E-03		7.80E-02	1.91E-01	**	3.24E-02	1.44E-01	**	5.47E-02
Key person is Hispanic	-6.19E-02		8.77E-02	1.00E-02		1.04E-01	8.38E-02	**	3.01E-02	9.23E-02		5.10E-02
Key person is other race	1.30E-02		1.43E-01	1.23E-01		1.54E-01	1.40E-01	**	4.22E-02	1.31E-01		7.22E-02
No. of own children under 18	-3.70E-02		5.87E-02	-9.31E-02		5.48E-02	1.52E-02		9.87E-03	7.15E-02		6.20E-02
No. of own children under 5	-5.34E-02		1.33E-01	-1.41E-01		1.45E-01	4.36E-02	**	1.82E-02	-5.21E-03		4.47E-02
Man is under age 25	-4.80E-03		6.52E-02	3.04E-01	**	6.99E-02	-5.63E-02		7.82E-02	-1.76E-01	**	5.46E-02
Man is age 35 to 44	4.73E-02		6.41E-02	2.24E-02		6.51E-02	-4.67E-02		3.62E-02	1.80E-01	**	7.80E-02
Man is age 45 to 54	-3.83E-01	**	8.29E-02	-3.26E-01	**	8.75E-02	-3.60E-01	**	3.11E-02	6.42E-01	**	1.02E-01
Man is age 55 to 64	4.88E-01	**	7.77E-02	4.47E-01	**	8.26E-02	3.71E-01	**	4.84E-02	1.52E-02		1.53E-02
Man is age 65+	1.05E+00	**	8.60E-02	1.45E+00	**	1.26E-01	7.28E-01	**	5.59E-02	-2.19E-02		2.70E-02
Man's years of schooling	-3.42E-02	**	7.84E-03	-1.42E-02		9.04E-03	-2.98E-02	**	3.21E-03	4.51E-02		9.88E-02
Man is disabled	4.57E-01	**	5.87E-02	5.09E-01	**	7.00E-02	6.40E-01	**	1.87E-02	-3.03E-02		4.77E-02
Man is not key person	---		---	---		---	-1.89E+00	**	9.55E-02	-3.47E-01	**	5.44E-02
Not key person * schooling	---		---	---		---	-3.79E-02	**	6.51E-03	3.32E-01	**	7.65E-02
Not key person * age < 25	---		---	---		---	1.38E-01		1.17E-01	1.00E+00	**	9.69E-02
Not key person * age 35 to 44	---		---	---		---	1.66E-01	**	5.82E-02	-2.96E-02	**	5.89E-03
Not key person * age 45 to 54	---		---	---		---	-9.26E-02		6.14E-02	5.91E-01	**	3.51E-02
Not key person * age 55 to 64	---		---	---		---	2.82E-01	**	6.11E-02	-1.77E+00	**	1.66E-01
Not key person * age 65+	---		---	---		---	1.67E+00	**	6.95E-02	-2.96E-02	**	1.20E-02
Wife is under age 25	---		---	---		---	6.45E-02		4.73E-02	3.13E-01	**	1.59E-01
Wife is age 35 to 44	---		---	---		---	1.10E-02		3.19E-02	4.62E-02		9.82E-02
Wife is age 45 to 54	---		---	---		---	-2.10E-01	**	2.91E-02	-1.70E-01		1.25E-01
Wife is age 55 to 64	---		---	---		---	3.20E-01	**	4.64E-02	2.43E-01	**	1.18E-01
Wife is age 65+	---		---	---		---	6.08E-01	**	5.30E-02	1.26E+00	**	1.54E-01
Wife's years of schooling	---		---	---		---	-1.27E-02	**	3.58E-03	-1.87E-03		6.32E-03
Wife is disabled	---		---	---		---	7.06E-02	**	2.10E-02	5.80E-02		3.88E-02
Sample size	24,183			24,183			92,440			92,440		

SOURCE: MATH STEWARD model database, 1992–1994 data from 1992 SIPP panel. Fixed effects for individual months not shown. Standard errors adjusted for clustering.
** = significantly different from zero (.05 level), two-tailed test.

- indicators for black, Hispanic, and other nonwhite persons;
- counts of the number of own children under the age of 18, the number of other children in the household, and the total size of the household;
- indicators that one (and one's spouse, if applicable) is under the age of 25, age 35 to 44, age 45 to 54, age 55 to 64, and age 65 and over;
- years of schooling completed by oneself and one's spouse (if applicable);
- a disability indicator for oneself and one's spouse; and
- year and quarter indicators.

Tables B.4 and B.5 display the estimated parameters of the food stamp participation and AFDC/TANF participation equations, respectively. In general, rates of program participation tend to be higher when unemployment rates are higher and when gains in disposable income from participation are higher, although the latter relationship was not clearly concave in the case of AFDC/TANF participation within single female or single male households. In the case of single male households, the estimated relationship between unemployment rates and food stamp participation was slightly negative but statistically insignificant, so this equation was re-estimated with the coefficient constrained to be zero for simulation purposes. Rates of program participation tend to be higher when there has been initial participation in the program and a longer cumulative tenure in the program. Households with black or Hispanic key persons, with several children in the household, or with elderly/disabled key persons and spouses are generally more likely to participate in food stamps and AFDC/TANF. The only variable consistently associated with lower rates of FSP and AFDC/TANF participation is the years of schooling completed by the key person and spouse, if applicable.

TABLE B.4
Probit Estimates of FSP Participation Equations for the MATH STEWARD Model, Versions 1996.70/1996.80

Variable	*Single Female Households*			*Single Male Households*			*Married-Couple Households*		
	Coefficient		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*
Constant term	-1.41E+00	**	1.17E-01	-1.49E+00	**	1.45E-01	-2.18E+00	**	1.34E-01
State unemployment rate (%)	6.48E-03		1.04E-02	0.00E+00	(coef. set to zero)		3.89E-03		9.96E-03
Gain in income from FSP	4.89E-03	**	1.99E-04	4.34E-03	**	3.55E-04	2.80E-03	**	1.84E-04
Gain in income^2 from FSP	-4.87E-07	**	5.50E-08	-7.69E-08		9.92E-08	-4.24E-07	**	6.51E-08
Initial FSP status	3.27E-01	**	4.18E-02	3.67E-01	**	7.82E-02	1.76E-01	**	4.69E-02
Net FSP tenure	2.70E-01	**	6.37E-03	2.66E-01	**	1.24E-02	2.96E-01	**	6.88E-03
Net FSP tenure^2	-5.84E-03	**	1.96E-04	-5.49E-03	**	3.91E-04	-6.84E-03	**	2.32E-04
Key person is black	1.96E-01	**	3.51E-02	2.82E-01	**	6.92E-02	2.55E-01	**	4.76E-02
Key person is Hispanic	1.75E-01	**	4.61E-02	-9.22E-02		9.63E-02	1.07E-01	**	4.44E-02
Key person is other race	-4.81E-02		1.02E-01	3.47E-01	**	9.49E-02	6.77E-02		6.33E-02
No. of own children under 18	3.62E-02		2.91E-02	-7.96E-02		5.44E-02	-2.52E-01	**	2.94E-02
No. of other children under 18	5.41E-02		4.58E-02	-6.11E-02		5.85E-02	-1.02E-01	**	4.51E-02
Household size	-2.30E-02		2.28E-02	5.99E-03		3.25E-02	2.20E-01	**	2.31E-02
Woman is under age 25	3.40E-01	**	5.63E-02	---		---	1.32E-02		7.19E-02
Woman is age 35 to 44	-2.02E-01	**	4.88E-02	---		---	-2.43E-01	**	4.45E-02
Woman is age 45 to 54	-1.06E-01		5.56E-02	---		---	1.30E-01		7.02E-02
Woman is age 55 to 64	-4.25E-02		5.94E-02	---		---	-2.77E-01	**	9.42E-02
Woman is age 65+	1.61E-01	**	5.00E-02	---		---	-1.26E-01		1.09E-01
Woman's years of schooling	-4.10E-02	**	4.71E-03	---		---	-4.17E-02	**	5.85E-03
Woman is disabled	3.74E-01	**	3.25E-02	---		---	2.73E-01	**	3.66E-02
Husband is under age 25	---		---	1.05E-01		9.37E-02	2.80E-01	**	9.31E-02
Husband is age 35 to 44	---		---	-4.55E-02		8.06E-02	5.31E-02		4.41E-02
Husband is age 45 to 54	---		---	8.97E-03		9.52E-02	-1.50E-01	**	6.57E-02
Husband is age 55 to 64	---		---	6.59E-02		9.19E-02	1.48E-01		8.51E-02
Husband is age 65+	---		---	2.31E-01	**	7.90E-02	2.45E-01	**	1.07E-01
Husband's years of schooling	---		---	-5.94E-02	**	7.80E-03	-3.48E-02	**	5.17E-03
Husband is disabled	---		---	2.50E-01	**	5.82E-02	3.13E-01	**	3.43E-02
Sample size	43,721			22,261			86,535		

SOURCE: MATH STEWARD model database, 1992–1994 data from 1992 SIPP panel. Fixed effects for individual months not shown. Standard errors adjusted for clustering.
** = significantly different from zero (.05 level), two-tailed test.

TABLE B.5
Probit Estimates of AFDC/TANF Participation Equations for the MATH STEWARD Model, Versions 1996.70/1996.80

Variable	*Single Female Households*			*Single Male Households*			*Married-Couple Households*		
	Coefficient		*S. E.*	*Coefficient*		*S. E.*	*Coefficient*		*S. E.*
Constant term	-3.84E-01	**	1.91E-01	-1.63E+00	**	4.54E-01	-2.02E+00	**	2.83E-01
State unemployment rate (%)	1.62E-02		1.59E-02	5.66E-02		3.46E-02	8.75E-02	**	1.99E-02
Gain in income from AFDC	2.05E-03	**	2.46E-04	3.69E-04		6.28E-04	3.87E-03	**	2.77E-04
Gain in income^2 from AFDC	5.19E-08		6.18E-08	5.18E-07	**	2.00E-07	-1.69E-07	**	6.42E-08
Initial AFDC status	1.23E-01	**	5.41E-02	-1.14E-01		1.86E-01	2.51E-01	**	9.70E-02
Net AFDC tenure	2.48E-01	**	8.28E-03	3.64E-01	**	2.74E-02	2.68E-01	**	1.34E-02
Net AFDC tenure^2	-4.94E-03	**	2.52E-04	-1.07E-02	**	1.03E-03	-6.18E-03	**	4.30E-04
Key person is black	2.43E-01	**	4.58E-02	-6.00E-02		2.14E-01	1.21E-01		7.73E-02
Key person is Hispanic	2.48E-01	**	5.72E-02	-7.86E-01	**	1.81E-01	-8.30E-02		8.47E-02
Key person is other race	1.20E-01		1.36E-01	5.68E-01		3.00E-01	-4.39E-01	**	1.04E-01
No. of own children under 18	8.98E-02	**	3.05E-02	1.02E-01		9.74E-02	1.16E-02		4.17E-02
No. of other children under 18	9.78E-02	**	4.20E-02	2.91E-01	**	9.92E-02	2.11E-01	**	5.79E-02
Household size	1.61E-02		2.57E-02	9.98E-02		7.08E-02	1.15E-01	**	3.75E-02
Woman is under age 25	3.61E-01	**	6.32E-02	---		---	-8.15E-02		1.13E-01
Woman is age 35 to 44	-1.60E-01	**	4.86E-02	---		---	-1.75E-01	**	8.29E-02
Woman is age 45 to 54	1.36E-01		1.12E-01	---		---	1.79E-01		1.67E-01
Woman is age 55 to 64	-2.04E-01		1.10E-01	---		---	-2.70E-01		1.91E-01
Woman is age 65+	3.01E-01	**	1.42E-01	---		---	-2.12E-01		4.31E-01
Woman's years of schooling	-5.01E-02	**	8.75E-03	---		---	-1.09E-02		1.30E-02
Woman is disabled	1.39E-01	**	5.11E-02	---		---	2.12E-01	**	6.47E-02
Husband is under age 25	---		---	2.80E-01		1.62E-01	3.55E-01	**	1.23E-01
Husband is age 35 to 44	---		---	-2.65E-01		1.58E-01	-8.67E-02		8.24E-02
Husband is age 45 to 54	---		---	7.28E-02		2.61E-01	-1.50E-01		1.21E-01
Husband is age 55 to 64	---		---	-3.02E-01		2.49E-01	2.96E-01		1.55E-01
Husband is age 65+	---		---	-3.20E-01		3.60E-01	-2.71E-01		3.28E-01
Husband's years of schooling	---		---	-2.84E-02		2.43E-02	-4.20E-02	**	1.06E-02
Husband is disabled	---		---	3.57E-01	**	1.45E-01	2.55E-01	**	6.19E-02
Sample size	9,958			1,859			39,276		

SOURCE: MATH STEWARD model database, 1992–1994 data from 1992 SIPP panel. Fixed effects for individual months not shown. Standard errors adjusted for clustering.
** = significantly different from zero (.05 level), two-tailed test.

4. Estimation of Correlation of Work/Welfare Choices

The use of bivariate probit procedures enabled us both to estimate the correlation of the unobserved factors that influenced work and program participation decisions and to use correlated error terms in the simulation. Table B.6 presents the estimated correlations, each of which was significantly different from zero. With correlations in excess of 0.74, the highest degrees of correlation occurred were between the residual for FSP participation and the residual for AFDC participation for households eligible for both programs. The residual for non-work (assumed to be the same as the residual for non–full-time work) was strongly correlated with the residuals for FSP and AFDC participation, especially for single females. It is possible that these correlations would be lower if the same model were estimated from SIPP data from the late 1990s, during which time welfare reform emphasized the establishment of work requirements for TANF recipients.

TABLE B.6
Estimated Correlation of Unobserved Factors Determining Work and Program Participation Outcomes
For the MATH STEWARD Model, Versions 1996.70/1996.80

	Correlation	*S. E.*	*No. of Obs.*	*Restrictions on Sample*
Single-Female Households				
FSP participation and female non-work	0.4498	0.0222	43,721	FS-eligible households at some work choice
AFDC participation and female non-work	0.7041	0.0258	9,958	AFDC-eligible households at some work choice
FSP participation and AFDC participation	0.7490	0.0220	9,919	FS- and AFDC-eligible households at some work choice
Single-Male Households				
FSP participation and male non-work	0.3538	0.0400	22,261	FS-eligible households at some work choice
AFDC participation and male non-work	0.3618	0.0793	1,859	AFDC-eligible households at some work choice
FSP participation and AFDC participation	0.8337	0.0371	1,852	FS- and AFDC-eligible households at some work choice
Married-Couple Households				
Female non-work and male non-work	0.1009	0.0126	92,440	None
FSP participation and female non-work	0.1904	0.0189	86,535	FS-eligible households at some work choice
FSP participation and male non-work	0.4007	0.0210	86,535	FS-eligible households at some work choice
AFDC participation and female non-work	0.1751	0.0352	39,276	AFDC-eligible households at some work choice
FSP participation and male non-work	0.3164	0.0354	39,276	AFDC-eligible households at some work choice
FSP participation and AFDC participation	0.7908	0.0235	39,140	FS- and AFDC-eligible households at some work choice

SOURCE: MATH STEWARD model database, 1992–1994 data from 1992 SIPP panel. Standard errors adjusted for clustering.
All correlations are significantly different from zero (.05 level), two-tailed test.